

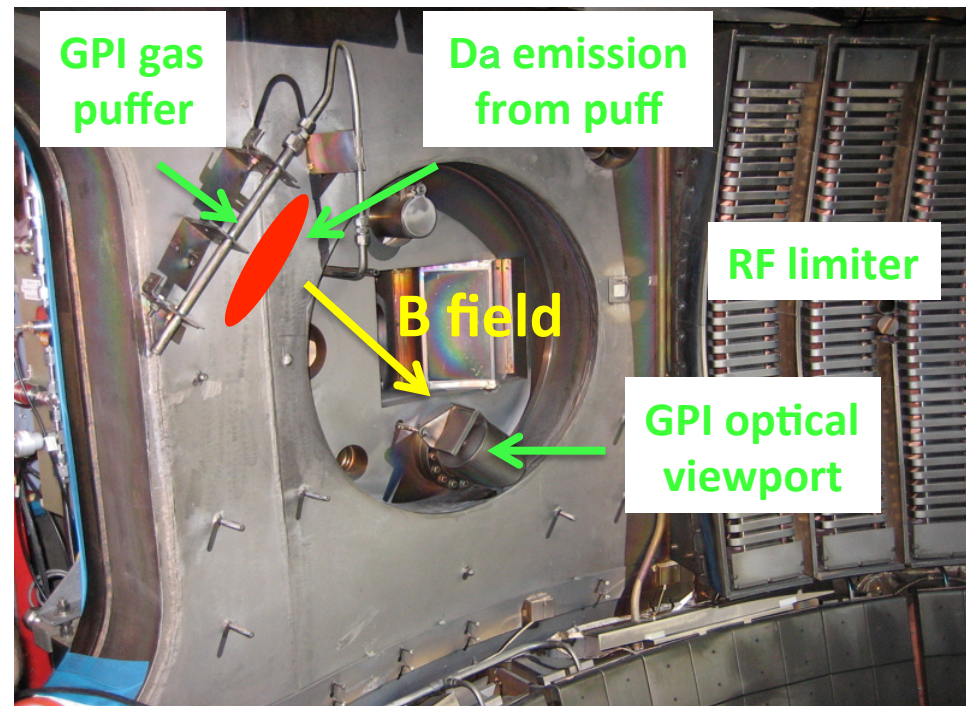
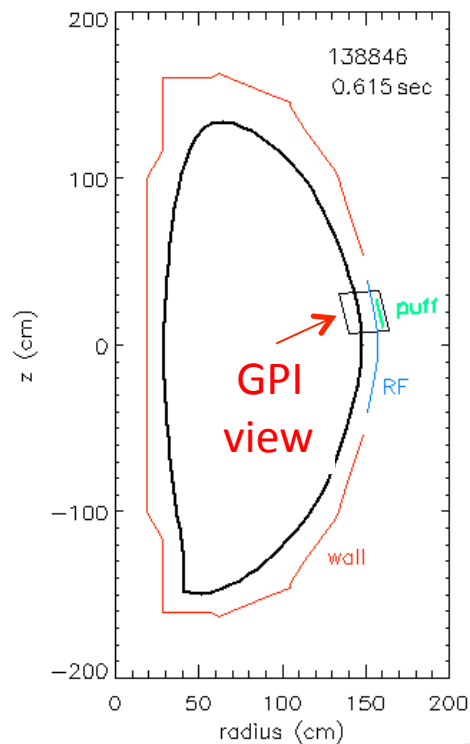
Gas Puff Imaging (GPI) in NSTX-U

S.J. Zweben, F. Scotti (LLNL), D.P. Stotler, A. Diallo,
B. Davis, N. Mandell, J.L. Terry (MIT), W. Han (MIT)

- Previous GPI in NSTX (up to 2010)
- New GPI hardware for NSTX-U
- GPI results from 2016 run
- Planned XPs and analysis

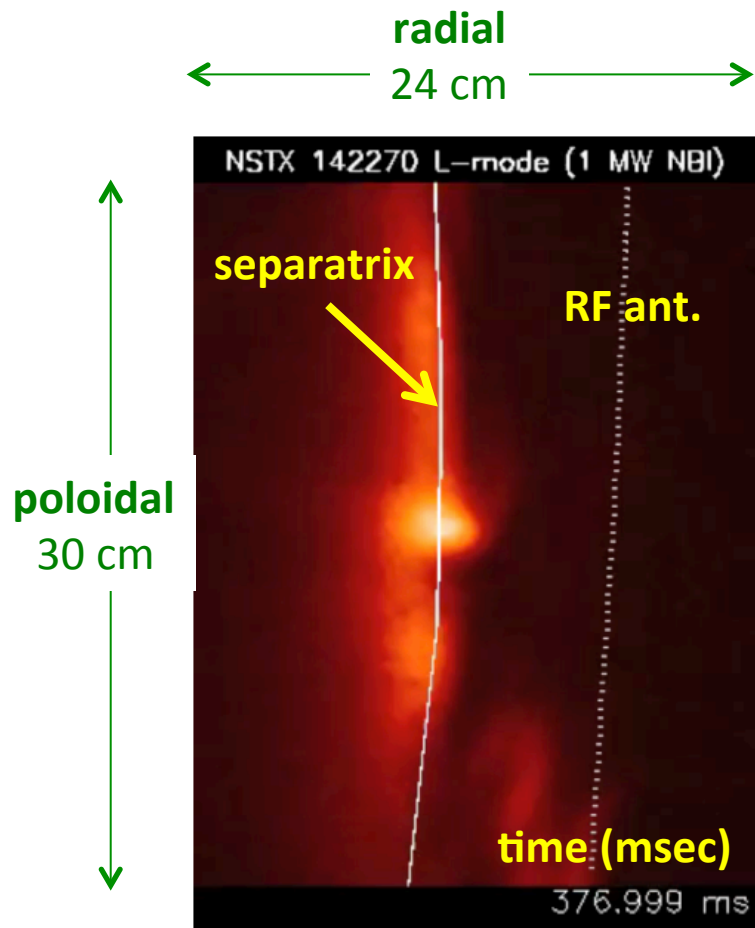
Gas Puff Imaging (GPI) Diagnostic on NSTX

- D_2 gas puffed from GPI manifold on outer wall above midplane
- D_α light emission from gas puff viewed from along local B field
- Fluctuations in D_α light emission interpreted as \tilde{n} turbulence

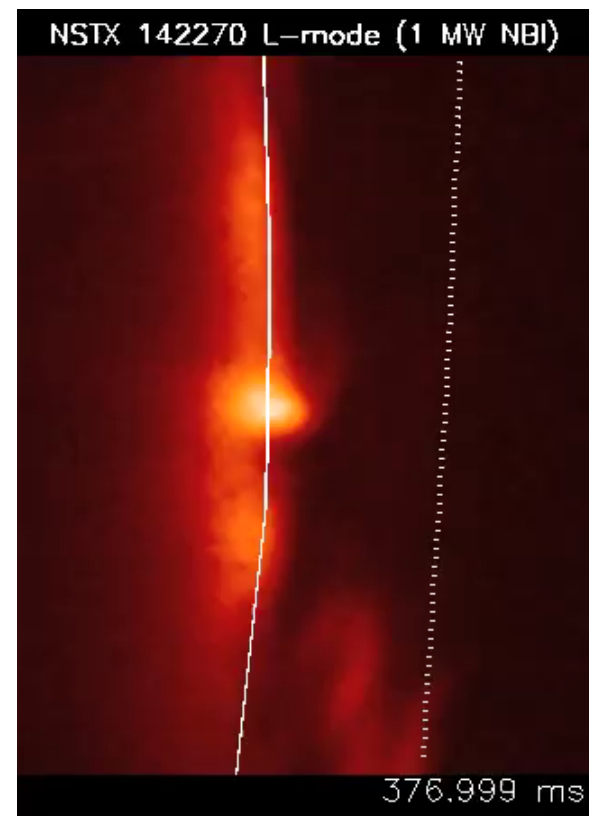


Example of NSTX GPI Data

- Exposure time/frame = $2.1 \mu\text{sec/frame}$ @ 400,000 frames/sec



1 msec movie



movies at <http://w3.pppl.gov/~szweben/NSTX2013/NSTX2013.html>

Analysis of Previous GPI Results

- We have outstanding database of GPI data from 2010 run, including ~320 good shots (thanks to R. Maqueda)
- Many papers have been written to describe this data and to compare the results with theory (thanks to J. Myra et al)
- The results are similar to many other devices, e.g. MAST

Yet the GPI data on edge turbulence is still not well understood, so further measurements and comparisons with theory and simulation (e.g. XGC-1) are appropriate

New GPI Hardware for NSTX-U

- New coherent imaging bundle (x3 larger signal)
- New D_a optical filter (x2-3 larger signal)
- New zoom lens (from ~5 mm to ~1 mm optical resolution)



look for possible small-scale structure in edge turbulence



reduce GPI gas puff rate for lower edge perturbation

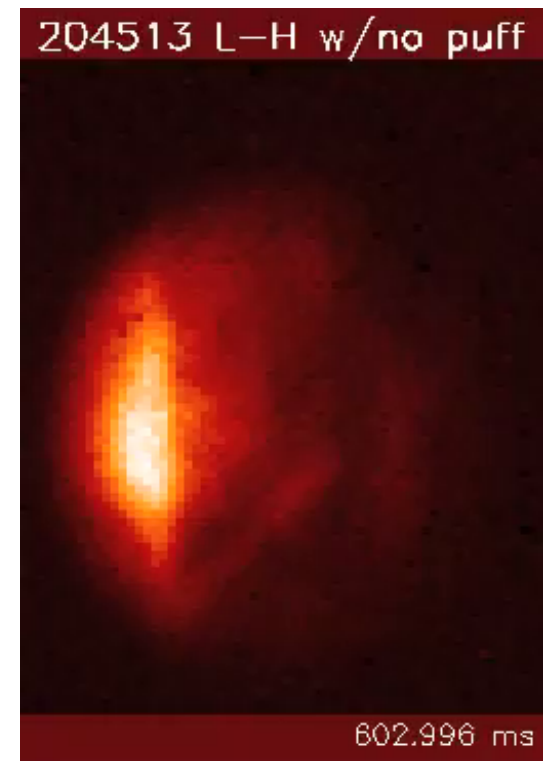


increase GPI gas puff length when needed to ≥ 1 sec

GPI Results from 2016 Run

- No GPI gas puff (piezo not connected), but rest of GPI system worked well
- Can see good signal in D_α background light at 100 kHz (vs. 400 kHz in NSTX)
- Edge turbulence looks as expected, but difficult to analyze due to 3-D effects
- Signal useful for comparison with ENDD neutral measurement (Stotler, Scotti)

4 msec movie



Planned GPI Hardware for NSTX-U

- 9x10 APD array for higher S/N in GPI (brought from C-Mod)
- Fast camera view of GPI puff from across machine (Scotti)
- Helium line ratio measurement of edge T_e and n_e profiles using GPI view, initially at $f \leq 1$ kHz (Wisconsin/Padova)

Future:

- Additional GPI view(s) for measuring 3-D filament structure
- Better collimated gas manifold for higher spatial resolution
- Remote control of GPI pan/zoom for small-scale structure

Planned XPs for NSTX-U

- Search for small-scale edge turbulence structure at $k_{\text{pol}}r_i \sim 1$ (Mandell, Ren, Guttenfelder)
- Correlation of edge turbulence with heat flux SOL width and XGC-1 results (Gray, Chang)
- Continue study of L-H transition (Diallo, Stoltfus-Dueck)
- Measure edge $q(r)$ from turbulence filament tilt angle using GPI + side view fast camera, like SAMI (Scotti)

Analyze 2010 GPI database for effects on edge turbulence of: divertor geometry, divertor detachment, RF fields, and RMP perturbations, to motivate other possible XPs for next run